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Relationship between psychological factors and performance-based and self-reported disability in chronic low back pain

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Abstract Cross sectional study, performed in an outpatient university based pain rehabilitation setting. To analyze the relationship between psychological factors (psychosocial distress, depression, self efficacy, self-esteem, fear of movement, pain cognitions and coping reactions) and performance-based and self-reported

disability, as measured with a Functional Capacity Evaluation (FCE) and the Roland Morris Disability Questionnaire (RMDQ), in patients with chronic low back pain (CLBP). It has been suggested that a strong relationship exists between psychological factors and disability in patients with CLBP. In former research disability was often measured by self-report and seldom performance-based. Study sample consisted of 92 patients with CLBP admitted for multidisciplinary rehabilitation. Prior to treatment, all patients completed questionnaires to measure psychological factors and self-reported disability, and performed an FCE to measure performance-based disability. Correlation coefficients between psychological variables and FCE and self-reported disability were calculated. Multivariate linear regression analyses were performed with self-reported or performance based disability measures as outcome variables, and psychological measures as predictor variables. Out of 42 relations analyzed, 5 were statistically significant. This concerned one significant correlation between kinesiophobia and a subtest of FCE, and four correlations between psychological factors and RMDQ. No correlation was significant after the Bonferroni correction was applied ($P < 0.001$). The strength of significant correlations ranged from $r = -0.33$ to $r = 0.25$. The multivariate analysis revealed that psychological variables measured in this study could explain 19% of the variance of self-reported disability, with kinesiophobia being the only psychological variable that contributed significantly. The suggested strong relationship between psychological factors and performance-based and self-reported disability could not be confirmed in this study. This may implicate that the relationship between psychological factors and disability in patients with CLBP is not as unambiguous as suggested.

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Keywords Disability · Psychological questionnaires · Functional capacity evaluation · Roland Morris Disability Questionnaire · Performance test · Chronic low back pain

Introduction

A major issue in pain rehabilitation programs for chronic low back pain (CLBP) is the suggested relation between psychological factors and disability. This relationship is stressed in dominant models such as the bio-psychosocial model [57, 65], and the fear avoidance model [62, 63]. According to the bio-psychosocial model, patient's functioning is influenced by biological, psychological and social factors. Psychological factors such as distress (depression, anxiety, and fear), self-efficacy, fear-avoidance beliefs, coping styles and cognitive factors generally are presumed to have a substantial impact on back pain disability rather than biomedical or biomechanical factors [29, 30, 39, 43].

In several studies the relationship between psychological factors and disability in patients with CLBP has been investigated [43, 57, 65]. Most of these studies were performed with the use of questionnaires. In these studies contradicting results were found. Some studies showed significant relationships of moderate strength between psychological factors and self-reported disability [39, 44]. In other studies, however, this relationship could not be confirmed, as evidenced by weak correlations between psychological factors and self-reported disability in patients with CLBP [22, 47, 53].

The use of disability questionnaires, while inexpensive, practical and useful to measure self-reported disability, yields information that may not necessarily reflect the real capacity and disability in daily functioning [55]. In order to assess physical capacity, performance tests were introduced in rehabilitation practice over the last years. Assessing disabilities using different perspectives such as the patient and performance testing may lead to differences in disability assessed and in relationship between psychological factors and disability. Several studies demonstrated that the outcomes of both types of measures (self-report and performance tests) differ distinctly and correlate weakly to moderately [14, 25, 37, 46]. In some studies the relation between psychological factors and performance-based disability has been investigated [36, 47, 50, 55, 62]. The results of these studies, however, remain inconclusive because they focus on one or a few psychological factor(s) only, or use only one type of instrument (for example lifting or bicycling) to measure disability. The aim of this study was to further investigate the relationship between psychological factors and

performance-based next to self-reported disability in a sample of patients with CLBP.

Materials and methods

Patients

Ninety-two consecutive patients, who were referred for a multidisciplinary pain management program in the Center for Rehabilitation, University Medical Center Groningen, the Netherlands, and who agreed to participate, were included in this study. All patients had CLBP lasting longer than 3 months. Patients were referred by general physicians or medical specialists. All patients had signed informed consent. This study was part of a larger research program LOBADIS (Low Back Pain and Disability), funded by the Dutch government; ZonMw grant number 96-06-006. Inclusion criteria were: CLBP longer than 3 months, age between 18 and 65 years, and still at work, on modified work, or less than 1-year out of work due to CLBP. Exclusion criteria were: CLBP with an underlying specific medical cause, co-morbidity with severe negative consequences for physical and/or mental functioning (for example severe psychiatric disease), addiction to drugs, and insufficient knowledge of the Dutch language.

Procedures

Prior to the treatment program patients completed questionnaires assessing demographic data, patient's characteristics, disability and psychological variables. Additionally, patients performed tests according to the WorkWell Functional Capacity Evaluation (FCE) [48]. The study was approved by the Medical Ethical Committee of the University Medical Center Groningen.

Measures

Demographic variables (age, gender, education level) and patient characteristics (duration of current complaints, recurrences) were assessed with a self constructed questionnaire. A 100 mm Visual Analogue Scale (VAS) was used to measure current pain intensity, ranging from no pain (0 mm) to unbearable pain (100 mm).

Psychosocial distress was measured with the Symptom Checklist-90-Revised (SCL-90-R; 90 items). The total score, the Global Severity Index (GSI) reflects the severity of all answered statements as a global measure of mental and physical distress. Scores range from 90 to 450 [3]. Higher scores indicate higher levels of distress. Reliability and validity of the SCL-90-R are good [3, 6, 18, 41].

Depression was measured with the Dutch version of the Beck Depression Inventory (BDI; 21 items). Scores range from 0 to 63 [5]. The BDI is an efficient screening device for depression in patients with CLBP [40]. Reliability and validity are satisfactory [5, 9, 11].

Self efficacy was measured with the Dutch version of the General Self Efficacy Scale (Algemene Competentie Schaal; ALCOS-Short Form). The ALCOS-SF measures the subject's expectations of their capacities in general (17 items). Scores range from 100 (lowest) to 500 (highest self efficacy). The reliability and construct validity of the ALCOS-SF are satisfactory [10]. A validated Dutch-language pain-specific self efficacy measure was not available during this study.

Self-esteem was measured with the Dutch version of the Rosenberg Self-Esteem Scale (SES). Scores range from 1 (lowest) to 40 (highest) [8]. It consists of ten items, five of them positively worded and five negatively worded. A positively worded item is for example: 'I feel good about myself'. A negatively worded item is for example: 'I certainly feel useless at times' [56]. Reliability and construct validity are satisfactory [8].

Fear of movement and (re) injury was measured with the Dutch version of the Tampa Scale of Kinesiophobia (TSK). The questionnaire consists of 17 items scored on a 4-point scale. Scores range from 17 (low fear) to 68 (high fear). Reliability and validity of the Dutch version are good [23, 62].

Pain cognitions were measured with the Pain Cognition List, experimental version (PCL-E). The PCL-E measures the verbal-cognitive response system of pain in five subscales. Each item presents a specific pain cognition statement, for example 'My thoughts are always concentrated on the pain' and the patient is asked to indicate agreement or disagreement on a 5-point Likert scale. (1 = totally disagree; 5 = totally agree). The following subscales are distinguished: pain impact (17 items, subscale scores ranging from 17 to 85), catastrophizing (17 items, subscale scores ranging from 17 to 85), outcome efficacy (7 items, subscale scores ranging from 7 to 35), acquiescence (4 items, subscale scores ranging from 4 to 20), and reliance on health care (5 items, subscale scores ranging from 5 to 25). Reliability and validity are sufficient [60, 61, 64].

Coping reactions were measured with the Utrecht's Coping List (UCL). Scores range from 47 (lowest) to 188 (highest). The following subscales are distinguished: palliative reaction, active coping, social support, avoidance, expression of emotions, passive coping, and coping self statements. Reliability and validity are moderate to good [54].

To assess disability both a performance test as well as a questionnaire was used.

Performance-based disability was measured with the WorkWell FCE, formerly known as the Isernhagen Work Systems (IWS) FCE. An FCE is a battery of tests that measure the ability to perform work-related activities that are used in disability assessments [16]. Although near full FCEs were performed, to assess the ability to perform work related activities specific for patients with CLBP, only low-back related subtests from the FCE were selected for analyses: lifting, carrying two handed and static forward bent test (Table 1) [32, 48]. In patients with CLBP, the lifting tests appear to be the single most important tests, as it is largely predictive of the performance of other test items [26, 27]. Test-retest reliability of these subtests has been established in patients with CLBP [12, 24, 48]. All patients were tested by a physiotherapist, who was trained, certified and experienced in administering FCEs.

Self-reported disability for activities of daily living was measured with the Roland Morris Disability Questionnaire (RMDQ), a widely used health status measure to assess self-reported disability due to low back pain. The RMDQ consists of 24 items. Total scores range from 0, representing no disability, to 24, representing severe disability [51, 52]. Construct validity, internal consistency and reproducibility of the RMDQ are good [7, 59]. The Dutch version of the RMDQ has proven to be a reliable instrument to measure self-reported functional status in CLBP patients [13].

Statistical analysis

All statistical analyses were performed with SPSS. Firstly, a missing data analysis was performed on the SCL-90-R and the RMDQ to ensure completeness of the questionnaires [35]. Missing items of the SCL-90-R were substituted by means of the remaining items of the dimensions. The

Table 1 Description of the activities of the WorkWell Functional Capacity Evaluation (FCE) used in this study

| FCE activity | Description | Scoring |
|--------------------------|---|---|
| Lifting | 5 lifts from table to floor vice versa; 4–5 weight increments; <90 s | Maximum amount lifted (kg) |
| Short carry two handed | 5 carries of 1.5 m vice versa; waist height; 4–5 weight increments; <90 s | Maximum amount carried (kg) |
| Static forward bend test | Standing with 30–60° trunk flexion; manipulating nut/bolts | Time position is held (s). Maximum of 15 min (900 s) |

substitution criterion used here allowed the substitution of, at the most, one missing item for five completed ones. For the RMDQ the total number of missing items was corrected using the following formula: $\text{sum score RMDQ} = [\text{total yes}/(24 - \text{missing})] \times 24$. Secondly, the distribution of the data was checked for normality (Kolmogorov–Smirnov Test). Depending on the distribution of the data, a *t* test or a Mann–Whitney test was used to test differences in scores (questionnaires) or performances (FCE) between males and females. Depending on normality Pearson's or Spearman's correlation coefficients were used to express the relationships between psychological questionnaires and the FCE-tests and the RMDQ. Multivariate linear regression (method: enter) analyses were performed with self-reported or performance based disability measures as outcome variables, and psychological measures as predictor variables. Based on the univariate relationships, predictor variables were only entered in the model when $P < 0.10$. Interpretation of correlation coefficients: $r \leq 0.49$ ($r^2 < 24\%$): weak relationship, $0.50 \leq r \leq 0.74$ ($25\% < r^2 < 55\%$): moderate relationship, and $r \geq 0.75$ ($r^2 > 55\%$): strong relationship [45]. A two-tailed significance level was set at $\alpha = 0.05$. A Bonferroni correction was applied to reduce type I error in interpreting the data (0.05 divided by 42) correlation analyses: $\alpha = 0.001$.

Results

Sample characteristics

The study sample consisted of 92 patients, of which 65% ($n = 60$) were male. Mean age of the patients was 38.5 years (SD 8.7). The duration of the current low back pain episode was not normally distributed; median was 52 weeks (interquartile range 24–150). In 91% of the patients the LBP was recurrent. The mean current VAS was 50 mm (SD 21.5 mm). Sixty five percent of the patients had completed lower level education only (primary school, lower vocational education), 35% were higher educated (intermediate vocational, higher vocational or university education). Twelve percent of the patients were single, 88% were married or living together.

Psychological and disability status

The results of the psychological measures, as well as the performance-based and self-reported disability measures are presented in Table 2. The scores on most questionnaires were normally distributed, except for duration of low back pain episode, the subscales expression of emotions and passive coping of the UCL and the static forward bend test of the FCE. Due to an administrative problem in the

Table 2 Descriptive statistics of variables measured in 92 patients with chronic low back pain

| Variable | <i>n</i> | Mean (SD) |
|--|----------|---------------|
| Psychological variables | | |
| SCL-90-R | 86 | 123.3 (26.6) |
| BDI | 82 | 7.3 (5.7) |
| ALCOS-SF | 88 | 69.6 (9.1) |
| SES | 86 | 33.5 (4.2) |
| TSK | 85 | 36.4 (5.6) |
| PCL | | |
| Pain impact | 70 | 43.8 (8.0) |
| Catastrophizing | 71 | 40.2 (11.4) |
| Outcome efficacy | 71 | 20.2 (4.0) |
| Acquiescence | 69 | 8.9 (2.5) |
| Reliance on health care | 71 | 19.2 (3.4) |
| UCL | | |
| Palliative reaction | 73 | 17.0 (3.0) |
| Active coping | 71 | 18.3 (2.8) |
| Social support | 73 | 12.7 (2.9) |
| Avoidance | 73 | 15.2 (2.5) |
| Expression of emotions ^a | 73 | 6 (5–6.5) |
| Passive coping ^a | 73 | 10 (9–11.5) |
| Coping self statements | 73 | 11.9 (2.7) |
| Disability | | |
| Lifting performance (kg) | 92 | 27.8 (14.7) |
| Men | 60 | 32.5 (15.4) |
| Women | 32 | 18.8 (7.8) |
| Carrying performance (kg) | 88 | 31.8 (16.4) |
| Men | 56 | 35.9 (17.4) |
| Women | 32 | 24.4 (11.4) |
| Forward bending performance (s) ^a | 91 | 156 (108–273) |
| Men ^a | 59 | 173 (86–273) |
| Women ^a | 32 | 149 (115–278) |
| RMDQ | 92 | 12.6 (4.8) |
| Men | 60 | 12.7 (5.0) |
| Women | 32 | 12.5 (4.5) |

SCL-90-R Symptom Checklist-90- Revised, *BDI* Beck Depression Inventory, *ALCOS-SF* General Self Efficacy Scale-Short Form, *SES* Rosenberg Self Esteem Scale, *TSK* Tampa Scale of Kinesiophobia, *PCL-E* Pain Cognition List, experimental version, *UCL* Utrecht's Coping List, *RMDQ* Roland Morris Disability Questionnaire

^a Due to a skewed distribution, median and interquartile range are presented

start of the study, twenty-one patients (23%) did not fill out the PCL, and of these patients 19 (21%) did not fill out the UCL as well. A missing data analysis revealed that the characteristics of those patients who did not fill out the PCL and the UCL ($n = 19$ –21; non-responders) did not differ significantly from responders with regards to age, gender, duration of complaints, VAS pain and RMDQ ($n = 71$), indicating that systematic differences between

responders and non-responders did not occur. Differences between males and females were non-significant in forward bending performances ($P = 0.48$) and the RMDQ ($P = 0.43$), and were significant in lifting the lifting and carrying performances (both $P < 0.01$).

Relation between psychological variables and disability

The correlation coefficients between psychological variables and disability measures are presented in Table 3. Out of all relationships analyzed, five were statistically significant ($P < 0.05$), and none were significant after the Bonferroni correction was applied ($P < 0.001$). The strength of those correlations that were significant ($P < 0.05$) ranged from $r = -0.33$ to $r = 0.25$. Relationships were also analyzed separately for males and females. Correlation coefficients of these subgroups were either non-significant, or of similar strength compared to the full group (coefficients not presented). In the static forward bend test two patients reached the maximum duration (900 s) of the test. This ceiling effect might influence statistics. Therefore correlations without these outliers were also calculated. This selection did not influence outcome (results not shown).

None of the performance variables associated significantly ($P < 0.10$) with more than one psychological variables. Multivariate analyses were, therefore, not performed. All psychological variables that associated significantly ($P < 0.10$) with self-reported disability were entered as predictor variables into a multivariate regression analysis (Table 4). The model explained 19% of the variance, with kinesiophobia being the only one psychological variable that contributed significantly. Multicollinearity did

not bias the model, because the average of variance inflating factors (VIF) was not substantially greater than one, and none of the VIF-values were greater than ten.

Discussion

The relationships between psychological factors and disability measures were studied in patients with CLBP. Out of all relationships analyzed, five were statistically significant at $P < 0.05$, and none were significant after the Bonferroni correction was applied ($P < 0.001$). The strength of the significant correlations ($P < 0.05$) ranged from $r = -0.24$ to $r = 0.33$, indicating weak relationships. The multivariate analysis revealed that psychological variables measured in this study could explain 19% of the variance of self-reported disability, with kinesiophobia

Table 4 Multivariate linear regression ($n = 62$)

| Dependent variable | Predictors | B | SE | P value | VIF | r^2 |
|--------------------|--------------------|-------|------|---------|------|-------|
| RMDQ | Constant | -4.82 | 5.53 | 0.39 | | 0.19 |
| | SCL-90-R | 0.03 | 0.03 | 0.38 | 1.85 | |
| | BDI | 0.00 | 0.16 | 1.00 | 2.20 | |
| | TSK | 0.27 | 0.11 | 0.01 | 1.19 | |
| | PCL pain impact | 0.02 | 0.08 | 0.80 | 1.54 | |
| | UCL social support | 0.31 | 0.19 | 0.11 | 1.04 | |

SCL-90-R Symptom Checklist-90-Revised, *BDI* Beck Depression Inventory, *TSK* Tampa Scale of Kinesiophobia, *PCL-E* Pain Cognition List, experimental version, *UCL* Utrecht's Coping List, *RMDQ* Roland Morris Disability Questionnaire, *VIF* variance inflating factors

Table 3 Correlations between psychological scores and Functional Capacity Evaluation and RMDQ in patients with chronic low back pain ($n = 68$ –92)

| | Lifting ^a | | Short carry two handed ^a | | Forward bend test standing ^b | RMDQ ^a |
|-----------------|------------------------------|------------------------------|-------------------------------------|------------------------------|---|-------------------|
| | Men | Women | Men | Women | | |
| SCL-90-R | -0.03 | 0.21 | -0.08 | 0.00 | -0.14 | 0.25* |
| BDI | -0.05 | 0.20 | -0.08 | 0.01 | -0.08 | 0.26* |
| ALCOS-SF | -0.06 | -0.04 | 0.08 | -0.08 | -0.10 | 0.03 |
| SES | 0.02 | -0.12 | 0.05 | 0.15 | 0.05 | -0.04 |
| TSK | -0.04 | -0.09 | -0.17 | -0.07 | -0.24* | 0.33* |
| PCL-E subscales | -0.06 to 0.24 | -0.19 to 0.10 | -0.11 to 0.18 | -0.33 to -0.02 | -0.15 to 0.08 | 0.08 to 0.24* |
| UCL subscales | -0.14 to 0.04 ^{a/b} | -0.31 to 0.20 ^{a/b} | -0.26 to 0.06 ^{a/b} | -0.04 to 0.12 ^{a/b} | -0.16 to 0.19 | -0.17 to 0.21 |

SCL-90-R Symptom Checklist-90- Revised, *BDI* Beck Depression Inventory, *ALCOS-SF* General Self Efficacy Scale-Short Form, *SES* Rosenberg Self Esteem Scale, *TSK* Tampa Scale of Kinesiophobia, *PCL-E* Pain Cognition List, experimental version, *UCL* Utrecht's Coping List, *RMDQ* Roland Morris Disability Questionnaire. Differences in *n*: refer to text

^a Pearson correlation, ^b Spearman correlation, applied at UCL subscales 'expression of emotions' and 'passive coping', and the static forward bend test

* $P < 0.05$

being the only one psychological variable that contributed significantly. The overall picture that arises from this study is that relationships between psychological variables and disability in CLBP are non-existent or weak, regardless whether a performance-based or a self-report measure for disability is used.

Commonly it is assumed, that psychological factors are strongly related to disability in patients with CLBP [65]. In former research distress [57], cognitions [66], depression [19, 20], self efficacy and self esteem [2, 4, 36], and fear of movement/reinjury [15, 38, 62, 63] have been reported to correlate moderately to measures of functional capacity in patients with CLBP (r ranging from -0.50 to 0.59). Some studies, however, show moderate, weak or non-existent relationships between functional capacity and psychological factors (r ranging from -0.04 [47] to -0.37 [49] or r^2 of 34% or less [15]). Strengths of correlations between the psychological factors and disability inferred from self-report only range between non-existing and moderate (r ranging from -0.73 to 0.59) [1, 2, 17, 21, 22, 33, 34, 42]. Overall, reported strength of relationship between measures of psychosocial distress and measures of self-reported or performance-based disability vary from non-existent to moderate. The results of our study appear to fit in the weaker side of the strength-spectrum, indicating relative independence between psychological variables and disability as measured with an FCE or the RMDQ.

One out of five significant relationships found in this study involved a relation between psychological variables and performance testing, while four out of these five relationships involved self-reports only. This difference may be explained by the different means of testing disability: performance-based tests and self-reports appear to measure different aspects of disability [46, 55]. Because in former research, the relationship between depression (assessed with the BDI) and disability (assessed with the Sickness impact profile (SIP) was much stronger for women than for men [33], we also analyzed the relationship for men and women. No gender differences in relationships between all measured psychological factors and performance based or self reported disability were found in our data.

The strengths of relationships reported in this study appear lower than relationships reported by most others. A possible explanation for the findings in this study may be a difference in sample characteristics. The characteristics of the patients in this study, however, show no meaningful and significant differences with other samples of patients with CLBP. The age of the studied sample is not relevantly different from other study samples [21, 33, 34, 36, 42, 47, 50, 62]. The duration of complaints is difficult to compare because of different definitions used in several studies (for example in- or excluding former episodes of pain). Mean

VAS-pain scores show no relevant differences to other studies [33, 34, 42, 47, 50, 55]. The levels of psychosocial distress (SCL-90-R) reported in this study are not relevantly different from the scores of a group unselected patients with low back pain and/or abdominal pain [41] or a group of patients with low back pain, hip- or pelvis-pain [3]. Our SCL-90-R scores are not different from other studies concerning CLBP in multidisciplinary treatment centers [31]. The BDI [22, 55], and TSK scores [34, 47, 50, 55, 62] are also not different. The scores on the RMDQ are not relevantly different from samples studied elsewhere [47, 55]. Because we found no meaningful differences in characteristics in the different patient groups, we concluded that our study sample represents the usual patients with CLBP. Therefore, it is unlikely that differences in study results can be attributed to a difference in patient characteristics.

Some limitations of this study have to be mentioned. Twenty-one patients did not fill out the PCL and/or UCL due to an administrative problem at the start of the study. Patient characteristics and scores on the RMDQ, however, showed no differences compared to the other patients. Therefore, including these patients in the study does not likely influence study results. Only three physical tasks of a FCE were analyzed in this study. Generalizations towards overall performance-based disability must be made with care [46]. However, as mentioned earlier, the lifting test alone has demonstrated great predictive validity of overall FCE performances in patients with CLBP [28]. The broad range of measures of psychological factors is a strength of this study. The instruments to assess the different psychosocial factors were chosen based on sufficient reliability and validity. The questionnaires appear suitable for the study and were also frequently used in former studies concerning this subject. The fact that two operational definitions of disability (both performance-based and self-report) were used can also be considered as a strength of this study.

For clinical practice it is important to unravel the components of the bio-psychosocial model and their suggested strong relationships in patients with CLBP. It has been mentioned before that despite the general conclusions about psychological factors and disability, the results of research into this issue must be interpreted cautiously [58]. In this study it is demonstrated that the suggested strong relationship cannot be confirmed with the combined use of questionnaires to assess psychological factors and an objective measure of functional capacity in an FCE as well as self-reported disability. Further research is desirable to unravel the relationship between psychological factors and disability in patients with CLBP. Additionally, further research aimed at unraveling determinants of disability in CLBP should not be restricted to psychological factors only, but include biological and social factors as well.

Conclusion

The suggested strong relationship between psychological factors and performance-based and self-reported disability in CLBP could not be confirmed in this study. This may implicate that the relationship between psychological factors and disability is not as unambiguous as suggested for patients with CLBP.

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